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Shedding Light on Restful Sleep

Renske Lok, PhD (Stanford University)

Light. We are exposed to it every day. It allows us to perceive our environment – the sunrise, the sunset, the shadows, colors, and edges of the world. Light is a powerful force that also impacts our brains. It affects how we feel, when we sleep, and how alert we are. How can light do all this? How can light change our behavior?

Light and the timing of sleep

There is a clock within our brain. This clock is called the circadian clock (often referred to as the circadian rhythm or biological clock). The circadian clock is an internal time keeping system that helps our body and behaviors function on a ~24-hour cycle. For example, the circadian clock regulates our sleep-wake patterns and controls alertness. Don't think that is important? Think about what happens when you try to sleep or be awake at the wrong time of day. The circadian clock synchronizes with the external environment to ensure we experience peak wakefulness during daylight hours and rejuvenating sleep at night. What does this have to do with light? Light exposure plays an essential role in determining the timing of the circadian clock. The circadian clock is remarkably sensitive to light. Even brief encounters with morning or evening light can profoundly influence the timing of the circadian clock!

When the circadian clock receives light in the morning, it interprets this as the start of the day. This signal makes the circadian clock speed up. What does that mean? The circadian clock shifts to an earlier hour. This can result in an earlier wake-up time the next day. This process is known as a "phase advance". On the other hand, when the circadian clock receives light in the evening (especially just before regular bedtime), it interprets this as the day lasting longer. This can trigger the circadian clock to slow down. This can result in difficulty falling asleep at night or going to bed later. This process is known as a "phase delay".

Importantly, the circadian clock naturally runs slightly slower than a strict 24-hour day. This means our bodies tend to want to sleep and wake up later each day. This also means it is harder to try to wake up earlier than it is to try to sleep in later. Luckily, we can use light to help adjust our circadian clock! To keep our sleep schedule on track, we need to get light exposure regularly. This is especially important if we want to wake up earlier.

Light and alertness

Light does not just affect when we sleep. Light can also make us more awake and alert. When we use light in the right way, it can help us work better and be more focused. Especially in the evening, light can make us feel more alert and improve how well our brain works. We know this from what people report about how awake they feel, and also from tests that assess mental performance. Light can also help us stay alert and think clearly during the day. Some types of light, especially those with a lot of blue in them, can make our memory better, help us pay attention, and make us react faster. So, light is like a tool that can help us stay awake and do our best thinking.

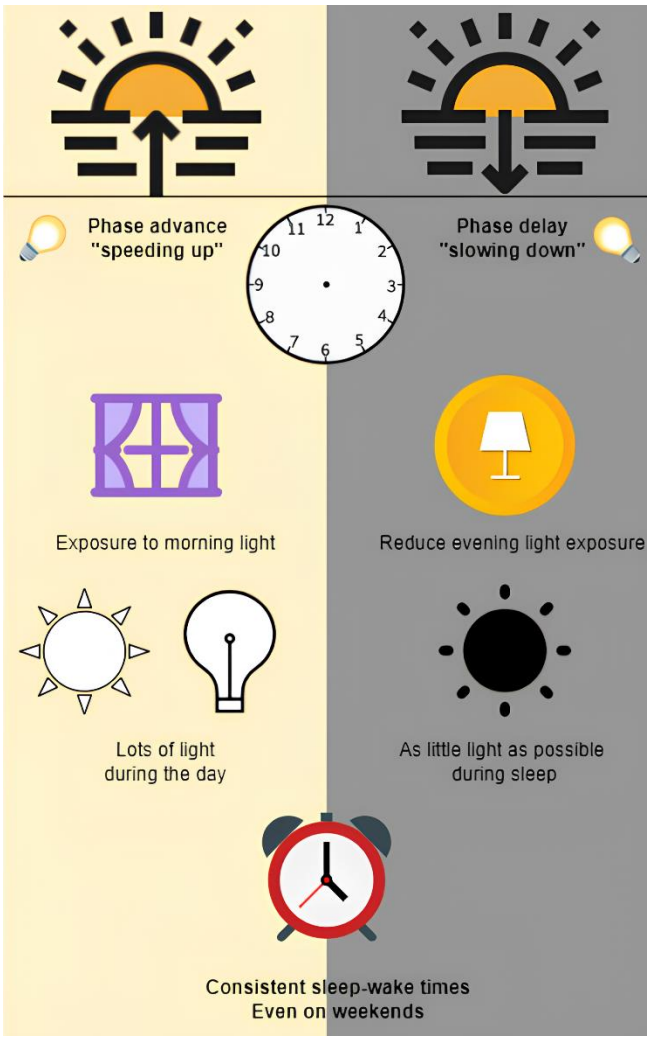
Light can be a valuable ally to help us sleep at night. Light can also help us stay awake and perform better during the day. It is important to find the right balance! Exposure to bright artificial light for too long (especially late in the evening) can make it hard to wind down and prepare for sleep. It can also impact the quality of our sleep. The key is to use light to stay alert (when necessary), but also to listen to our body's natural signals to wind down as bedtime approaches.

Scientists are still trying to determine how much light is best for our bodies (during the day and at night). One study gave us some ideas about the right light levels to support our body functions, sleep quality, and how well we perform during the day.[1] It is also important to remember that light at night can indirectly disturb our sleep. The ability to turn on a light at night allows us to engage in activities that we normally wouldn't be able to do in the dark. For example, reading, watching TV, playing games, or talking with friends. These activities can end up delaying bedtime and disturbing sleep. It is not just the light itself, but what we do under its glow that can affect how well we sleep.

Smartphone usage and sleep

In the modern digital age, the soft glow of smartphone screens has become an ever-present part of our daily lives. Many studies have explored how smartphone light before bedtime impacts alertness, sleep quality, and sleep onset. In general, phones and tablets produce relatively low levels of (blue) light. The light level is even lower when we use dark backgrounds, turn on "night mode", and lower screen brightness. This amount of light can impact how awake we feel, but it often does not do so. What affects our sleep is *how* we use our devices. Social media can keep us up late and affect how quickly we fall asleep. So, it is not just the light itself, but our actions that impact our sleep.

Promoting healthy light habits



We can use light to help our circadian clock wake and sleep at the right times of day (morning and evening).

•Welcome morning sunlight, even if you are a night owl: It is super important to get sunlight in the morning. This is especially important if you like staying up late and sleeping in. Go outside or simply let the morning sunlight in through your curtains when you wake up. This morning light helps synchronize your circadian clock. It tells your clock it is daytime and promotes wakefulness. For night owls, getting sunlight in the morning can help your body adjust ("phase advance"). This will make it easier to wake up earlier and start your day.

•Reduce evening light exposure: Decrease exposure to artificial light in the evening. Gradually dim the lights in your living space 1 to 2 hours before bedtime. This signals to your body that it is time to wind down for sleep. This step is particularly important for night owls who tend to stay up late.

•Limit light exposure during sleep: Make your sleep environment as dark as possible. For example, use blackout curtains. These curtains help create a perfectly dark and cozy sleeping space.

Stick to a regular sleep schedule: Go to bed and wake up at about the same times every day. Stick to these times even on weekends. This routine helps stabilize the circadian clock. It also ensures you are exposed to light in a consistent pattern.

[1] Brown, T. M. *et al.* Recommendations for daytime, evening, and nighttime indoor light exposure to best support physiology, sleep, and wakefulness in healthy adults. *PLoS Biology* **20**, e3001571 (2022).

2510 North Frontage Road
Darien, IL 60561
Phone: 630.737.9702
coordinator@srsnet.org